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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
TOMOYOSHI ITO	: EXAMINER: CHANG, A. Y.
SERIAL NO: 10/500,461	:
FILED: JULY 14, 2004	: GROUP ART UNIT: 2872
FOR: MOVING-IMAGE HOLOGRAPHIC REPRODUCING DEVICE AND COLOR MOVING-IMAGE HOLOGRAPHIC REPRODUCING DEVICE	:

REPLY BRIEF UNDER 37 CFR 41.37

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

This is a Reply Brief to the Examiner's Answer dated April 30, 2009.

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I. 41.37(C)(1)(III) Status of Claims

Claims 7 and 10-13 are pending and appealed. Claims 1, 4, 5-6, 8, and 9 are canceled.

Claims 7 and 10-11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the patent issued to Kato et al (U.S. Pat. No. 5,852,504) in view of Sekiguchi et al (U.S. Pat. No. 5,798,864) and in view of Popovich et al (U.S. Pat. No. 6,115,152) and Eichenlaub (U.S. Pat. No. 65,410,345). Claims 12 and 13 stand rejected under 35 U.S.C. § 102(a) as being unpatentable over Kato et al and Sekiguchi et al and Popovich et al and Eichenlaub in view of Fukagawa et al (U.S. Pat. No. 6,510,446) and Ohno (U.S. Pat. No. 6,232,940).

II. 41.37(C)(1)(VI) Grounds of Rejection for Review

Whether the rejection of Claims 7 and 10-11 under 35 U.S.C. § 103(a) as being unpatentable over Kato et al in view of Sekiguchi et al and in view of Popovich et al and Eichenlaub should be reversed. Whether the rejection of Claims 12 and 13 under 35 U.S.C. § 102(a) as being unpatentable over Kato et al and Sekiguchi et al and Popovich et al and Eichenlaub in view of Fukagawa et al and Ohno should be reversed.

III. 41.37(c)(1)(vii) Arguments

A. Regarding the 35 USC 103 Rejection of Claims 7 and 10-11

1. The Examiner posits that either a laser diode or a light emitting diode can be used to illuminate a reflective holographic display

The Examiner states on page 4 of the Examiner's Answer:

> Kato et al teaches that a *semiconductor laser light source* (134, please see column 11, lines 40-42) is used to illuminating the reflective liquid crystal display via a *half mirror* (142) such that a three dimensional image of the objects, (objects used for calculating the computer generated holographic fringe information) is reconstructed from the reflective liquid crystal display device and is *projected* by the *half mirror* to an observer, (please see Figure 28, columns 11-12).
>
> This reference has met all the limitations of the claims with the exception that it does not teach *explicitly* that the light sources are three light emitting diodes of primary colors red, green and blue. Kato et al does teach a *full color display* wherein three light sources each generating one primary color of light are being used to illuminate the display *at same time*, (please see Figure 36 of Kato et al and column 11, lines 44-53 and column 14, lines 36-46). Kato et al teaches that the light sources are *semiconductor laser* but does not teach explicitly that the semiconductor laser light sources are light emitting diodes. But one skilled in the art would understand that a semiconductor laser is one type of a *light emitting diode light sources* for they all based on same semiconductor p-n junction structure for emitting the light. Popovich et al in the same field of endeavor also teaches that either laser diode (semiconductor laser) or light emitting diodes, (LEDs) can be used to illuminate a reflective holographic display to provide the reconstructed full color holographic image, (please see column 21, line 28 to column 22, line 6). It would then have been obvious to one skilled in the art to apply the teachings of Popovich et al to modify the display device of Kato et al to use high power LEDs as the light sources for producing the full color images for the benefit of using bright light sources with high output power and narrow bandwidth to improve the image quality.

2. In response, Appellant points out that a laser diode and a light emitting diode are different light sources providing different kinds of light which do not perform the same function and are not equivalent

Appellant's Claim 7 defines:

> A color moving-image holographic reproducing device comprising:

> (a) a computer configured to create a computer-generated hologram from three-dimensional coordinate data of a three-dimensional object which is externally obtained;
>
> (b) ***a reflective liquid crystal display*** connected to the computer and configured to display the computer-generated hologram;
>
> (c) a half mirror configured to project the displayed computer-generated hologram;
>
> (d) ***three light-emitting diodes*** of primary colors red (R), green (G), and blue (B) (LEDs) functioning as reference light source; and
>
> (e) ***the LEDs arranged on a two dimensional grid pattern and respectively emitting primary colors of light, red (R), green (G), and blue (B), at the same time,*** wherein a first LED of the R, G and B LEDs is disposed in the vicinity of a second LED in the horizontal direction and a third LED is disposed in the vicinity of the second LED in the vertical direction orthogonal to the horizontal direction;
>
> wherein optical axes of color light beams from the LEDs ***are shifted from each other***, the light beams are projected to the half mirror and onto the reflective liquid crystal display, and a color holographic image is formed from the computer-generated hologram. [Emphasis added]

Hence, the claimed invention sets forth ***a reflective liquid crystal display*** and LED light sources instead of a transmissive LCD and laser light sources as used in the conventional art. Appellants submit that the combination of LEDs and a reflection LCD (as claimed) is not disclosed or suggested in the prior art of electronic holography.

Appellants submit that, in holography, it is well known to use a laser light having high coherence for optical recording on and reconstruction from a hologram. Although the examiner alleges that "one skilled in the art would understand that a semiconductor laser is one type of a light emitting diode light sources," Appellant respectfully disagrees.

A semiconductor laser of Kato et al is not a LED and would not have been referred to by one of ordinary skill in the art at the time of the invention as a LED. Conversely, a LED is not a semiconductor laser and would not have been not referred to by one of ordinary skill in the art at the time of the invention as a semiconductor laser. LEDs are sources of ***incoherent light***, and their light intensity is lower than that of a laser light. Since holography requires coherent light, a semiconductor laser can be used for holographic recording, but not a LED.

A laser therefore has been used as reference light in conventional electronic holography techniques. However, the indiscriminate substitution of a laser for a LED and vice versa is not proper.

Indeed, Popovich et al describes holographic illumination systems for providing illumination and for projecting images. Figure 19 of Popovich et al shows a system for combing optical sources of different colors to generate polychromatic light in which three sources of light with different colors, red 1910R, green 1910G and blue 1910B are incident upon an HOE stack comprising three HOEs 1920R, 1920G and 1920B. Figure 20 of Popovich et al shows a system for combing optical sources through the use of separate reflective holographic optical elements where each element is "configured to diffract one of the three colors of light." While the examiner points to the commentary in Popovich et al at col. 21, line 66, to col. 22, line 5, regarding the use of monochromatic and polychromatic light sources including "other illumination sources, such as laser diodes, halogen lamps, incandescent lamps, induction lamps, arc lamps, or others, or combinations thereof," the Board will appreciate that the applicability of all these different monochromatic and broad band sources taught in Popovich et al is not a statement of the universal capability for lasers and LEDs to be substituted for each other, but rather is a statement that in Figure 20 of Popovich et al such a substitution is proper.

Accordingly, one skilled in the art at the time of the invention would have no rationale to adopt the teaching of Popovich et al to Kato et al.

3. The Examiner posits that that claimed invention "is arranged to the fused by human vision to form full color image" and that the "so-called on/off synchronization is achieved without the observer to notice any time difference between the different color image lights and it has to be done within the flicker fusion rate of human eye"

The Examiner states on pages 10 and 11 of the Examiner's Answer:

> In response to appellant's second argument, (appeal brief page 9, third paragraph), which states that Eichenlaub teaches that the LEDs light sources are turned on/off in synchronization which therefore differs from the instant application recites that the three LEDs light sources illuminate light at the same time and therefore teaches away from the instant application, the examiner respectfully disagrees. Firstly, the *scopes* of the claims is to provide full color image by using the three color light sources so that the three color image lights is arranged to be fused by human vision to form full color image and then visualized. This means the three color images have to be received by the observer *essentially* at the same time. Kato et al in Figure 36, shows that three color light beams arc emitting light at same time to achieve full color image display. Since Eichenlaub teaches explicitly that the three color lights are *fused* by vision of the observer, (please see column 12, lines 45-50), this means the three colors light images essentially reach the observer's eye at the same time. The so-called on/off synchronization is achieved without the observer to notice any time difference between the different color image lights and it has to be done within the flicker fusion rate of human eye. For otherwise individually distinct color images not the fused full color image will be observed. The LEDs light sources of Eichenlaub are *essentially* emitting color lights at the *same* time, as far as the observer is concerned. Since the light emission function of LEDs light sources of Eichenlaub achieves the *same* function and result as of the light emission function of LEDs light sources of the instant application, namely to provide full color image, there is no patently distinct or unexpected result between the two systems. Furthermore, Popovich et al in Figure 19, explicitly shows that the three primary color LEDs can be activated to *illuminate* light at the same time to reproduce the full color holographic image. To have the three color LEDs emitting the light at the same time or not (but within the human vision limitation to notice the difference) therefore does not provide any patentably different result, they are therefore considered to be obvious matters of design choice to one skilled in the art.

4. In response, Appellant points out that that scope of the claim is not limited to a human observer or the flicker fusion rate of human eye

Appellant **<u>firstly</u>** points out that that scope of the claim is not limited to a human observer or the flicker fusion rate of human eye. Thus, the examiner is making conclusions

about the claimed invention and how he believes the applied art reads on the claimed invention based on features **not** in the claimed invention.

For instance, as noted above, Claim 7 defines:

> (e) ***the LEDs arranged on a two dimensional grid pattern and respectively emitting primary colors of light, red (R), green (G), and blue (B), at the same time,*** wherein a first LED of the R, G and B LEDs is disposed in the vicinity of a second LED in the horizontal direction and a third LED is disposed in the vicinity of the second LED in the vertical direction orthogonal to the horizontal direction; [Emphasis added]

Emission of the red (R), green (G), and blue (B) LEDs "at the same time" is a claim element that is **not** met by a prior art teaching of light being emitted at the flicker fusion rate of human eye, even if for the sake of argument that is what the prior art teaches.

In Figure 9 of Sekiguchi, laser beams of different wavelengths emitted from first to third lasers 201a, 201b and 201c are successively subjected to selection of wavelength by first to third shutters 901a, 901b and 901c controlled by a shutter control circuit 905. Synchronizing with the operation in which the wavelength is selected by the shutters, Fraunhofer diffraction images corresponding to all wavelength components are displayed on an LC display 203.

Appellant submits that optical systems of this conventional art -- "three-panel color holography" and "single-plate time-multiplexing color holography" -- are not limited to holography and are used in other stereoscopic imaging technique such as stereopsis and two-dimensional imaging technique. In fact, Sekiguchi uses the optical system to display a projection image on a two-dimensional screen because it is well known in imaging technique to align RGB light beams on the same line.

Appellant **secondly** points out that Sekiguchi describes a "single-plate time-multiplexing color holography" technique(which the present application describes as

background art in the description and Figure 2) where one hologram is prepared, RGB color lights being turned **on and off** by corresponding electronic shutters are combined into one beam and displayed on the hologram **in a time-multiplexing sequence** of red, green and blue. The RGB components of the image are sequentially displayed on a single hologram **by using time-multiplexing** while RGB lights are synchronously projected onto the hologram. A color image is reconstructed by displaying the color components at a high enough time-multiplexing rate for human visual perception.

5. The Examiner posits that Kato et al suggests three light sources arranged in a grid or two dimensional pattern

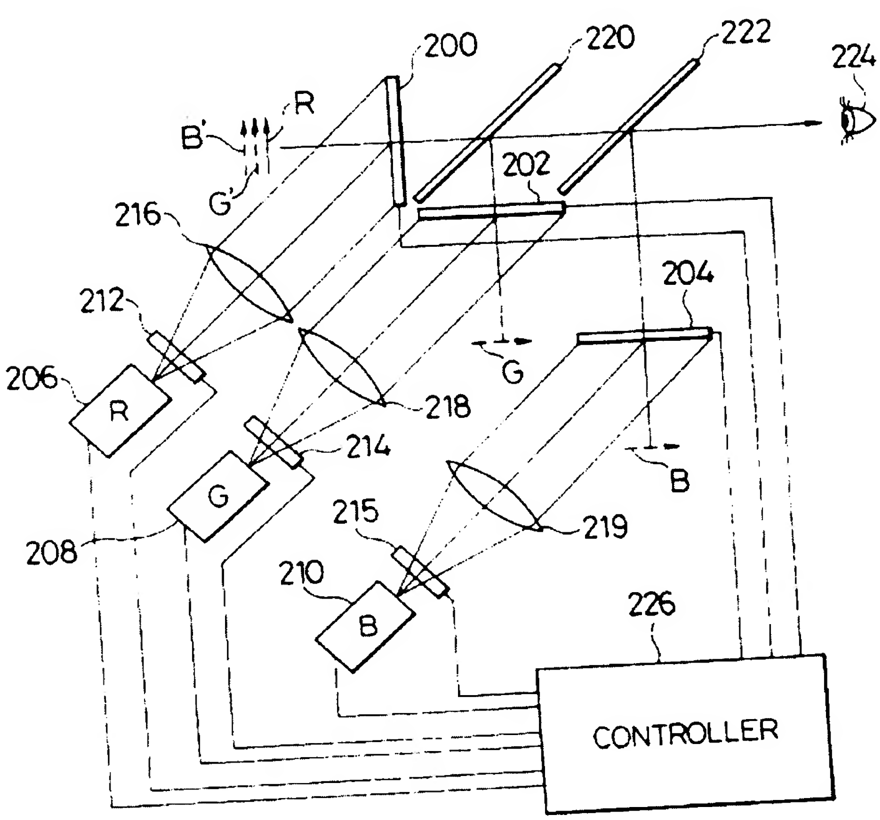
The Examiner states on page 10 of the Examiner's Answer:

> In regard to appellant's arguments concerning that the three color light sources shown in Figure 36 of Kato et al has to be linear not form a two-dimensional grid, the examiner respectfully disagrees for the reasons stated below. Firstly, one skilled in the art having basic optic knowledge would know that the collimated light beam from the light sources illuminate the spatial light modulators (200, 202 and 204) will not be beaded by the spatial light modulators since spatial light modulator normally does not have light refraction or bending property. Secondly, Kato et al reference in Figures 26-28, teaches the reproducing light (light generated by the light source (134) incidents on the spatial light modulator or the liquid crystal display *normally or perpendicularly*, this suggests that light beams from the light sources incident on the spatial light modulators perpendicularly or with normal incident angle. This means the light sources should be placed normally in aligned with each spatial light modulator to provide normal incidence of the reproducing light. This suggests the three light sources are arranged in grid or two dimensional pattern since the three spatial light modulators (200, 202 and 204, Figure 36) are arranged in two dimensional grid pattern.

6. In response, Appellant points out that the light modulating apparatuses in Kato (which the examiner needs for the asserted combination to work) are not themselves arranged on a two-dimensional grid pattern, but rather are arranged in a linear array

Appellant **firstly** points out that, in Figure 36 of Kato et al, reproduction lights are emitted from laser light sources 206, 208, 210 and are irradiated to space light modulating apparatuses 200, 202, 204 through shutters 212, 214, 215 and collimating lenses 216, 218, 219, thereby displaying RGB component solid images and synthesized color solid image in which RGB component solid images are overlapped. Figure 36 of Kato et al is reproduced below. There is no suggestion in Figure 36 of Kato et al that the laser light sources 206, 208, 210 would be misaligned.

FIG.36



Indeed, for the laser light sources 206, 208, 210 to be misaligned would require that the space light modulating apparatuses 200, 202, 204 be also misaligned. Neither condition is disclosed nor suggested in Kato et al. Rather, to the contrary, alignment of these components is disclosed.

Moreover, Appellant submits that it is well known in imaging technique to align RGB light beams on the same line. In fact, Sekiguchi uses an aligned optical system to display a projection image on a two-dimensional screen.

In the claimed invention, the RGB light beams are **out of alignment** on purpose. The reason why color display can be obtained in electronic holography by using the claimed invention is that the reconstructed image in holography is reconstructed by diffracted light and is **not** reconstructed from direct light from the reference light source. The diffracted light is emitted at an angle to the direct light. Therefore, the reconstructed image in holography can be formed away from the light path of the reference light.

For instance, Appellant's Figure 11 shows one illustrative embodiment of the color moving-image holographic reproducing device of Claim 7. In Figure 11, a reflective LCD 61 and an LED light source 63 (as a reference light source) both exist. Notice that, here as in Claim 7, there is no need to produce three holograms or no need to have synchronized shutters. Rather, LED light source 63 is a set of light sources in which R light source 63A, G light source 63B, and B light source 63C are grouped together, arranged in a grid pattern as shown in Figure 12(a), and emit at the same time. The claimed invention actively uses misalignment - -

> (e) the LEDs ***arranged on a two dimensional grid pattern*** and respectively emitting primary colors of light, red (R), green (0) and blue (B), at the same time, wherein a first LED of the R, G and B LEDs is disposed in the vicinity of a second LED in the horizontal direction and a third LED is disposed in the vicinity of the second LED in the vertical direction orthogonal to the horizontal direction;

> wherein ***optical axes of color light beams from the LEDs are shifted from each other***, the light beams are projected to the half mirror and onto the reflective liquid crystal display,.--.

As mentioned above, although it is well known in the conventional art to align optical axis of each RGB light beam on the same line, the optical axis of each RGB light beam in the claimed invention is shifted, and thus is out of alignment. Therefore, reflected lights RGB from the reflective LCD 61 at a diffractive, reconstruction position, which is distance d_3 from the LCD, are away distance d_7, and rectangular regions 69A (R), 69B (G) and 69C (B) are formed as shown in Figure 12(b). A color graphic is divided into R, G, and B components. Each component is drawn in the corresponding region shown in Appellant's Figure 13. The color components are combined at hologram reconstruction area 69D shown in Figure 12(b), and an original color graphic is reconstructed.

The claimed invention takes advantage of this holographic basis and the use of diffraction, and defines a patentably distinct optical system. Here, the claimed invention provides a significantly simplified color moving-image holographic reproducing device which can use only one hologram and which can produce the image without the need for time-multiplexing and the synchronized shutters, needed in the art to produce a holographic image.

The Board will appreciate that omission of elements and retention of function are considered indicia of non-obviousness.

Appellant **secondly** points out that it would appear that the examiner only considers the common components between Kato et al, and the claimed invention, such as for example the three color light sources, displays and half mirrors, without considering how the components in Kato et al would work (***or rather not work***) in the asserted combination. With regard to Figure 36 of Kato et al, the examiner assumes that space light modulating

apparatuses 200, 202, 204 are arranged on a two-dimensional grid pattern. However, light modulating apparatuses 200, 202, 204 are **not** arranged on a two-dimensional grid pattern, but rather laser light sources 206, 208 and 210 and light modulating apparatuses 200, 202, 204 are arranged in a linear array. Accordingly, if the laser light sources 206, 208 and 210 in Kato et al were rearranged to be in a two-dimensional grid pattern, then a further modification would be required for the light modulating apparatuses 200, 202, 204 to also be rearranged in a two-dimensional grid pattern.

7. The Examiner posits that the stereoscopic imaging techniques of Eichenlaub do represent a matter which would have logically commended itself to ones attention if one were addressing Appellant's problem of electronically-derived holographs

The Examiner states on page 8 of the Examiner's Answer:

> Since both the cited Kato et al reference (i.e., the primary reference) and the instant application use primary color light sources to illuminate a liquid crystal display device with image information, such as the computer generated hologram, to display a full-color image, the technique of *displaying image* using LCD display **not** the stereoscopic technique taught by Eichenlaub certainly is reasonably pertinent to one skilled in the art to facilitate the full color display of the image. The image display using LEDs light sources and the liquid crystal display device taught by Eichenlaub, which is independent from both holography and stereoscopic technologies, is a *shared* technique for *both* stereoscopic image display and the holographic image display, therefore is relevant and can be used as a basis for the rejection of the claimed invention.

8. In response, Appellant points out that the examiner's reasons are in error due to the prior art stereoscopic imaging requiring direct reproduction of the source light and Appellant's use of diffracted light to form an image

Appellant submits that problems with electronically-derived holographs (related to the claimed invention) are not related to **or reasonably pertinent to** the problems with stereoscopic imaging. In other words, as detailed below, the stereoscopic imaging techniques of Eichenlaub do not represent matter which would have logically commended itself to ones

attention if one were addressing Appellant's problem of electronically-derived holographs. Moreover, Appellant respectfully submits that the given examiner's reasons as to why problems with stereoscopic imaging are reasonably pertinent to a color moving-image holographic reproducing device are misconceptions.

Eichenlaub describes stroboscopic illumination system for video displays. Eichenlaub relates to stereopsis, not holography. Stereopsis uses binocular disparity and is a technique in which a viewer sees different viewpoint images of an object through right and left eyes. Holography is a technique that allows the light scattered from an object to be recorded and later reconstructed so that it appears as if the object is in the same position relative to the recording medium (as it was when recorded) and makes the recorded image appear three-dimensional.

The examiner asserts that "the technique of displaying image using LCD display not the stereoscopic technique taught by Eichenlaub certainly is reasonably pertinent to one skilled in the art to facilitate the full color display of the image." It would appear however that the examiner is broadly interpreting both the claimed invention and Eichenlaub as techniques of displaying images using a LCD display to facilitate the full color display of the images.

However, the Board will appreciate that one skilled in the art at the time of the invention would have understood that stereoscopic technique and electronic holography technique are fundamentally different and address different problems to be solved. These techniques essentially differ in that stereopsis uses direct light from a reference light to reconstruct images whereas holography uses diffracted light as described above. Since stereopsis uses direct light as it is, Eichenlaub describes an array system comprised of a large plurality of LEDs corresponding to pixels of a two dimensional display. On the other hand,

since electronic holography uses diffracted light, it is difficult to obtain color hologram by using an optical system using such a large plurality of LEDs.

Figure 13 of Eichenlaub describes an optical configuration of an LED-based color illumination system for 2-D displays in which LEDs are used as light sources to create the illumination required for generation of stereoscopic or enhanced resolution 2-D images. A large plurality of LEDs direct its light output toward a fly's eye lens which comprises a two-dimensional array of very small convex lenslets number of which is equal to the number of pixels in the LCD.

Accordingly, the device configurations of Eichenlaub and the claimed invention are totally different. In addition, the claimed invention not only uses a red LED, a green LED, and a blue LED but also groups them together and arranges these sources on a two dimensional grid pattern, whereas RGB light sources are disposed separately in the conventional art.

One of the purposes of Eichenlaub is to provide illumination systems for imaging devices for full resolution 3-D displays, look around 3-D displays and enhance resolution 2-D displays. One purpose of the claimed invention is to provide a simplified color moving-image holographic reproducing device using a reflective LCD and LEDs which can reconstruct high-resolution images. Both techniques do **not** have common problems to be solved, and accordingly optical components in each of these techniques perform different actions and have different functions. Appellant submits that it is unreasonable to compare Eichenlaub with the claimed invention and that one skilled in the art would **not** be motivated to adopt the teaching of Eichenlaub to Kato et al, given these differences in function.

Hence, for all these rebuttal reasons, the 35 U.S.C. § 103(a) rejection of Claims 7 and 10-11 should be reversed.

B. Regarding the 35 USC 103 Rejection of Claims 12 and 13

Claim 12 defines that the claimed color moving-image holographic reproducing device includes a dedicated high-speed parallel distributed processing system including a plurality of dedicated Large Scale Integrator LSIs ***between the computer and the reflective liquid crystal display***. Claim 13 defines that the dedicated high-speed parallel distributed processing system further comprises a shared memory for storing coordinates of an object, and defines that the plurality of dedicated LSI's are configured in parallel.

The Examiner's Answer essentially introduces a new ground for rejection of Claims 12 and 13 based on an apparent inherency position. The Examiner's Answer posits that, in Ohno, the LSI "has to be between the computer providing the data and the liquid crystal display." See page 12 of Examiner's Answer. Yet, Figure 6 of Ohno, which the examiner relied on in the final Office Action for a teaching of LSIs, shows in relation to Figure 6 of Ohno that the LSI is on a side of LCD display panel 1 which is not between LCD display panel 1 and LCD drive controller 6.

Hence, for this additional reason (besides their dependence from the allowable independent claims), the 35 U.S.C. § 103(a) rejection of Claims 12 and 13 should also be reversed.

IV. Conclusion

Appellant request on the basis of the arguments presented above that the outstanding grounds for the rejection be reversed.

Respectfully submitted,
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